Leaving The Land Better: Measuring Your Impact

Lisa Schulte Moore, Iowa State University, lschulte@iastate.edu
Department of Natural Resource Ecology & Management
In a Nutshell...

1. No one measure...

2. Determining the right ones for YOUR farm

3. Online tools offer multidimensional planning support

4. PEWI: People in Ecosystems/Watershed Integration
No one measure...
No one measure...

Farm

Water infiltration & runoff
Soil carbon & aggregate stability
Sediment transport & loss
Nitrogen, phosphorus loss
Prairie plant species & cover
Beneficial insects & pests
Birds & other vertebrates
Prairie biomass

Farmability
Field level financial profitability
Corn & soybean yields
Opportunity cost
Financial support
Other markets

Partners
Presentations
Event attendees
Media interest
Adopters
Fields & acres
Champions
No one measure...
1. No one measure...a practical guide

The Monitoring Tool Box

- Kudos to Margaret Smith
- Developed by farmers, ag advisors, & researchers
- Starts with YOUR goals
- Makes use of YOUR intuition, time, observations, & supplies you already have on the farm
- Helps you consider what’s feasible & how often you should measure
- Companion data worksheets

Land Stewardship Project
https://landstewardshipproject.org/
No one measure...

- Quality of Life
- Farm Sustainability with Financial Data
- Birds
- Frogs and Toads
- Soil
- Streams
- Pasture Vegetation

Land Stewardship Project
https://landstewardshipproject.org/
No one measure...

Farm Sustainability with Financial Data

- Farm profits
- Reliance on government programs
- Use of equipment, chemicals, and non-renewable energy
- Creation of jobs
- Balance between feed use and feed production

Land Stewardship Project
https://landstewardshipproject.org/
No one measure...but consider adding this one

Evaluating Soil Health Using Tea Bags

Marshall McDaniel
Teresa Middleton
Stefan Gailans

https://www.youtube.com/watch?reload=9&v=u-I9-pNE46U
No one measure...but consider adding this one

https://www.extension.iastate.edu/waterquality/

Image: Jamie Benning, ISU
No one measure...but consider adding this one
Determining the right ones for YOUR farm

A practical guide...

...but you may need some help

- Family New Year’s resolution?
- A neighborhood “book club”?
- Next year’s PFI Farminars?
- Work with a consultant?

Land Stewardship Project
https://landstewardshipproject.org/
Determining the right one for YOUR farm
Online tools offer multidimensional planning support.
Online tools offer multidimensional planning support

- Cool Farm Alliance Cool Farm Tool: https://coolfarmtool.org/
- Field To Market Fieldprint Platform: https://fieldtomarket.org/our-program/fieldprint-platform/
- Iowa State University PEWI: https://www.nrem.iastate.edu/pewi/
- University of Illinois IDEALS: https://www.ideals.illinois.edu/handle/2142/13458
- University of Nebraska’s Healthy Farm Index: http://extensionpubs.unl.edu/publication/9000016369664/the-healthy-farm-index/

Commercial tools
PEWI: People in Ecosystems/Watershed Integration
PEWI: People in Ecosystems/Watershed Integration

www.nrem.iastate.edu/pewi
4 categories → 16 indicators

PEWI

- 9 Yield
- 2 Soil Quality
- 3 Water Quality
- 2 Habitat
### PEWI nitrate module

<table>
<thead>
<tr>
<th>Description</th>
<th>Notation</th>
<th>Rule</th>
<th>Possible Values</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Watershed nitrate concentration</strong></td>
<td>$N$</td>
<td>$\sum_{i=1}^{n} \left[ \max \left{ 100 \times PW_i \sum_{j=1}^{m_i} R_{ij} C_{ij}, 2 \right} \times \frac{A_i}{A} \right] ]$</td>
<td>$2 \text{ mg L}^{-1} \leq N \leq 29.54 \text{ mg L}^{-1}$</td>
</tr>
<tr>
<td><strong>Subwatershed nitrate percent contribution</strong></td>
<td>$PC_i$</td>
<td>$\frac{\max \left{ 100 \times PW_i \sum_{j=1}^{m_i} R_{ij} C_{ij}, 2 \right} \times \frac{A_i}{A}}{N}$</td>
<td>$0 - 100%$</td>
</tr>
<tr>
<td><strong>Precipitation multiplier</strong></td>
<td>$P$</td>
<td>Dry: Precipitation current year $\leq 71.6$ cm</td>
<td>0.86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Normal after dry: Precipitation current year $= 77.2$ cm, $81.7$ cm, or $87.2$ cm; and Precipitation prior year $\leq 71.6$ cm</td>
<td>1.69</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wet after dry: Precipitation current year $\geq 92.6$; and Precipitation prior year $\leq 71.6$ cm</td>
<td>2.11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Background: All other climate cycles</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Wetland multiplier</strong></td>
<td>$W_i$</td>
<td>At least one strategic wetland in the subwatershed with wetland land use type</td>
<td>0.52</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No strategic wetland locations in the subwatershed with wetland land use type</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Row crop multiplier</strong></td>
<td>$R_{ij}$</td>
<td>Land use types: Conservation corn, Conservation soybean, Conventional corn, Conventional soybean, Mixed fruit and vegetable</td>
<td>0.14 $\times \frac{A_{ij}}{A_i}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Land use types: Alfalfa, Conservation forest, Conventional forest, Hay, Herbaceous bioenergy, Permanent pasture, Prairie, Rotational grazing, Short-rotation woody bioenergy, Wetland</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>Conservation row crop multiplier</strong></td>
<td>$C_{ij}$</td>
<td>Land use types in Des Moines Lobe: Conservation corn, Conservation soybean</td>
<td>0.69 $\times \frac{A_{ij}}{A_i}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Land use types in Southern Iowa Drift Plain: Conservation corn, Conservation soybean</td>
<td>0.62 $\times \frac{A_{ij}}{A_i}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Land use types: Alfalfa, Conservation forest, Conventional corn, Conventional forest, Conventional soybean, Hay, Herbaceous bioenergy, Permanent pasture, Prairie, Rotational grazing, Short-rotation woody bioenergy, Wetland</td>
<td>1.00 $\times \frac{A_{ij}}{A_i}$</td>
</tr>
</tbody>
</table>

---

*a (Randall & Mulla, 2001)*  
*b (Tom Isenhart, Iowa State University, personal communication, 2013)*  
*c (Schilling & Libra, 2000)*  
*d (Iowa, 2013)*
PEWI 3-D view
PEWI physical data layers
PEWI land uses

Hover options:

- Current Land Cover
- Current Precipitation
- Tile Soil Type
- Overlay Map Raw Score
- Subwatershed Number
- Flood Frequency
- Drainage Level
- Strategic Wetlands
PEWI precipitation levels

Year 0: 45.10
Year 1: 28.18
Year 2: 28.18
Year 3: 24.58
PEWI multiplayer mode
### PEWI results

<table>
<thead>
<tr>
<th>Land Use Category</th>
<th>Y1</th>
<th>Percentage</th>
<th>Y1</th>
<th>Units (English)</th>
<th>Y1</th>
<th>Units (Metric)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Grain</td>
<td>10.9</td>
<td>percent</td>
<td>644.5</td>
<td>acres</td>
<td>260.8</td>
<td>hectares</td>
</tr>
<tr>
<td>Conventional Corn Area</td>
<td>5.9</td>
<td>percent</td>
<td>346.5</td>
<td>acres</td>
<td>141</td>
<td>hectares</td>
</tr>
<tr>
<td>Annual Legume</td>
<td>6</td>
<td>percent</td>
<td>353.8</td>
<td>acres</td>
<td>143.2</td>
<td>hectares</td>
</tr>
<tr>
<td>Conventional Soybean Area</td>
<td>5.3</td>
<td>percent</td>
<td>309.8</td>
<td>acres</td>
<td>125.4</td>
<td>hectares</td>
</tr>
<tr>
<td>Mixed Fruits and Vegetables Area</td>
<td>7.4</td>
<td>percent</td>
<td>436.8</td>
<td>acres</td>
<td>176.8</td>
<td>hectares</td>
</tr>
<tr>
<td>Pasture</td>
<td>5.5</td>
<td>percent</td>
<td>326.0</td>
<td>acres</td>
<td>132.2</td>
<td>hectares</td>
</tr>
<tr>
<td>Permanent Pasture Area</td>
<td>7.1</td>
<td>percent</td>
<td>417.3</td>
<td>acres</td>
<td>166.9</td>
<td>hectares</td>
</tr>
<tr>
<td>Perennial Herbaceous (non-pasture)</td>
<td>6.4</td>
<td>percent</td>
<td>377.5</td>
<td>acres</td>
<td>152.0</td>
<td>hectares</td>
</tr>
<tr>
<td>Grass Hay Area</td>
<td>6.6</td>
<td>percent</td>
<td>369</td>
<td>acres</td>
<td>157.4</td>
<td>hectares</td>
</tr>
<tr>
<td>Switchgrass Area</td>
<td>6.2</td>
<td>percent</td>
<td>367</td>
<td>acres</td>
<td>148.5</td>
<td>hectares</td>
</tr>
<tr>
<td>Prairie Area</td>
<td>6.6</td>
<td>percent</td>
<td>366</td>
<td>acres</td>
<td>156.2</td>
<td>hectares</td>
</tr>
<tr>
<td>Wetland Area</td>
<td>7.3</td>
<td>percent</td>
<td>428.8</td>
<td>acres</td>
<td>173.5</td>
<td>hectares</td>
</tr>
<tr>
<td>Perennial Legume</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alfalfa Area</td>
<td>4.9</td>
<td>percent</td>
<td>287.0</td>
<td>acres</td>
<td>116.5</td>
<td>hectares</td>
</tr>
<tr>
<td>Perennial Wooded</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conventional Forest Area</td>
<td>7.2</td>
<td>percent</td>
<td>426.3</td>
<td>acres</td>
<td>172.5</td>
<td>hectares</td>
</tr>
<tr>
<td>Conservation Forest Area</td>
<td>6.6</td>
<td>percent</td>
<td>389.3</td>
<td>acres</td>
<td>157.5</td>
<td>hectares</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ecosystem Service Indicator / Measurement</th>
<th>Y1</th>
<th>Score</th>
<th>Y1</th>
<th>Units (English)</th>
<th>Y1</th>
<th>Units (Metric)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat Game Wildlife</td>
<td>70</td>
<td>(out of 100)</td>
<td>7</td>
<td>pts</td>
<td>7</td>
<td>pts</td>
</tr>
<tr>
<td>Habitat Biodiversity</td>
<td>35</td>
<td>(out of 100)</td>
<td>3.5</td>
<td>pts</td>
<td>3.5</td>
<td>pts</td>
</tr>
</tbody>
</table>
Coming soon to PEWI

Coming in 2019

• Separating out practices from land uses
  • Conventional till or no-till
  • Cover crops
  • Terraces, grass water ways, buffers
• More interactive feedback
• Economics module
  • Overview
  • Line item view
• More land use types
  • Apple and chestnut orchards
  • Apple and chestnut with hay alleys

Long Term Goals

• Integrating with Google Maps
PEWI Development Team:
Lisa Schulte Moore, Carrie Chennault, Robert Valek, Nancy Grudens-Schuck, John Tyndall, John VanDyk
Uma Abu, Katelyn Anderson, Assata Caldwell, Han-Shu Chang, Justin Choe, Nicolas De La Cruz, Ryan Frahm, Noah Hagen, Jacob Hill, Mitchell Kerr, Charlie Labuzzetta, Elizabeth Li, Elise Miller, Md Jawad Mashrur Rahman, Laura Roy, Alexander Schulz, Mehul Shinde, Nancy Shryock, Weijia Zhao

Funding:
And now back to Lee...
USE THE COOL FARM TOOL

AN ONLINE GREENHOUSE GAS, WATER, AND BIODIVERSITY CALCULATOR FOR FARMERS

FREE FOR FARMERS
The Fieldprint® Platform is a pioneering assessment framework that empowers brands, retailers, suppliers and farmers at every stage in their sustainability journey, to measure the environmental impacts of commodity crop production and identify opportunities for continuous improvement.

Farmers can access this free and confidential tool through our online Fieldprint® Calculator or through associated farm-management software that integrates the Platform's metrics and algorithms. Brands, retailers and suppliers can access aggregated data from farmers who opt-in to participate in their Fieldprint® Projects.
Introduction

Resource Stewardship (RS) is a voluntary service provided by NRCS through a new evaluation tool. RS enhances conservation planning by benchmarking the level of resource stewardship on the land and helping NRCS clients better identify their conservation goals and improve their outcomes.

RS uses a web-based platform to evaluate the health of soil, water, air and wildlife habitat. RS evaluates a user defined management system against the inherent site characteristics in order to perform this evaluation.

Upon the completion of RS, clients receive a report called the Resource Stewardship Evaluation (RSE) which visually graphs their stewardship achievements and suggests opportunities to improve resource stewardship. Evaluations are available for crop, pasture, range, forest, farmstead, and associated ag land uses.

If you would like a Resource Stewardship Evaluation completed on your operation, please reach out to your local NRCS office. To access Resource Stewardship, visit https://rs.sc.egov.usda.gov/Splash.aspx

The following graph shows an example visual from an RSE report, highlighting where a client’s operation scores on each of the criteria listed in comparison to the vertical blue threshold bar. The shaded bars suggest opportunities the client can take to meet or surpass the threshold bar and improve resource stewardship.
Illinois Farm Sustainability Calculator

The Illinois Farm Sustainability Calculator is a spreadsheet-based model capable of quantifying and analyzing some of the most important measures of agricultural sustainability for any farm in the state of Illinois. Users input data from their farm including soil information, the production area of each crop, nutrients added to the fields, tillage methods, the number and type of animals raised, livestock dietary requirements, energy sources used, building energy use, product hauling distances etc. The model takes these inputs, combines them with data concerning crop productivity, carbon sequestration and emissions, energy use for different types of tillage and buildings, alternative energy production, and many other subjects. From these parameters, IFSC produces final balance sheets for animal feed production vs. consumption, energy production vs. consumption, carbon sequestration vs. carbon emission, and nitrate runoff. It also indicates how many people the farm can feed. In other words, IFSC allows its user to discover whether or not their current farm design is sustainable and test it against any number of hypothetical farm designs until a sustainable design is reached. Development of the IFSC was funded by the Dudley Smith Initiative.
The Healthy Farm Index

Including Bird Observations in a Multi-factor Assessment
EC307

This publication provides an overview of the Healthy Farm Index and how farmers can use it to move toward goals they see as important for their farm. It includes a section on how to survey farm birds. Although developed on organic farms, the concepts apply to most farms and could be adapted to ranches or other lands.